Space Weather Technical Forecast

Issued on Tuesday 29 October 2024 at 14:44 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: S2 Moderate Solar Radiation Storm ongoing. Further M-class flares expected with chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M4.2 at 28/1628 UTC from AR3878 in the northeast.

Currently, there are eleven sunspots on the solar disc—ten numbered and one unnumbered. The largest is AR3872, positioned in a dense grouping in the southeast, now nearing the centre of the disc, with AR3873 to its east and AR3869 to its west. These regions have had a history of X-class flares, but have been undergoing simplification. In recent hours, the delta region at the rear of AR3872 has split, AR3869's positive leader spots have decayed into smaller spots, and nearly all positive leader spots in AR3873 have faded, save for one very small spot. AR3878 in the northeast continues to rotate away from the east limb, and still shows a strong delta spot within its large trailing spot. AR3876 in the south-centre and AR3874 in the northwest are both continuing to evolve but remain relatively simple bipolar groups. A new region is evident coming over the northeastern limb, but will need to rotate further on to the visible disc to conduct a proper analysis.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar environment has been under the influence of declining CME effects from a CME associated with the X1.8 flare which left the sun on 26 Oct and arrived at L1 the early on 28 Oct. Solar winds, observed by ACE, were initially elevated around 540 km/s and have then eased to slightly elevated levels of 480 km/s by the end of the period. Density was largely below average. Interplanetary Magnetic Field (IMF), Bt, was weak around 5-8nT. The north-south component, Bz, varied weakly. Phi angle remained negative (towards the Sun). The resulting geomagnetic activity was Quiet to unsettled (Kp2-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 persisted at S2 Moderate Storm, on a slow declining trend with peak 364 pfu at 28/1350 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The associated 24-hour fluence was well below the Active threshold, with 1.7e6 integrated flux observed at 29/0000UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is expected, with further M-class flares expected and a chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: There are no further CME arrivals currently expected. Ongoing CME influence is forecast to ease day 1 (29 Oct). Solar winds are expected to ease from Slightly elevated to Background, however some influence from the fast wind of CH85 may delay this until day 2 (30 Oct). Geomagnetic activity is forecast to ease to be mainly Quiet with isolated Unsettled intervals from day 1 (29 Oct) onward.

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is currently at S2 moderate radiation storm levels, on a slow declining trend. A gradual decay is now expected, likely persisting just above the S2 level initially and decaying through the S1 level for the rest of day 1, and potentially into day 2 (29-30 Oct). Any further notable flares from the regions approaching centre disc in the south will bring the potential for further enhancement. The high energy electron flux is expected to be mainly Background, with the associated fluence forecast to persist below Active.

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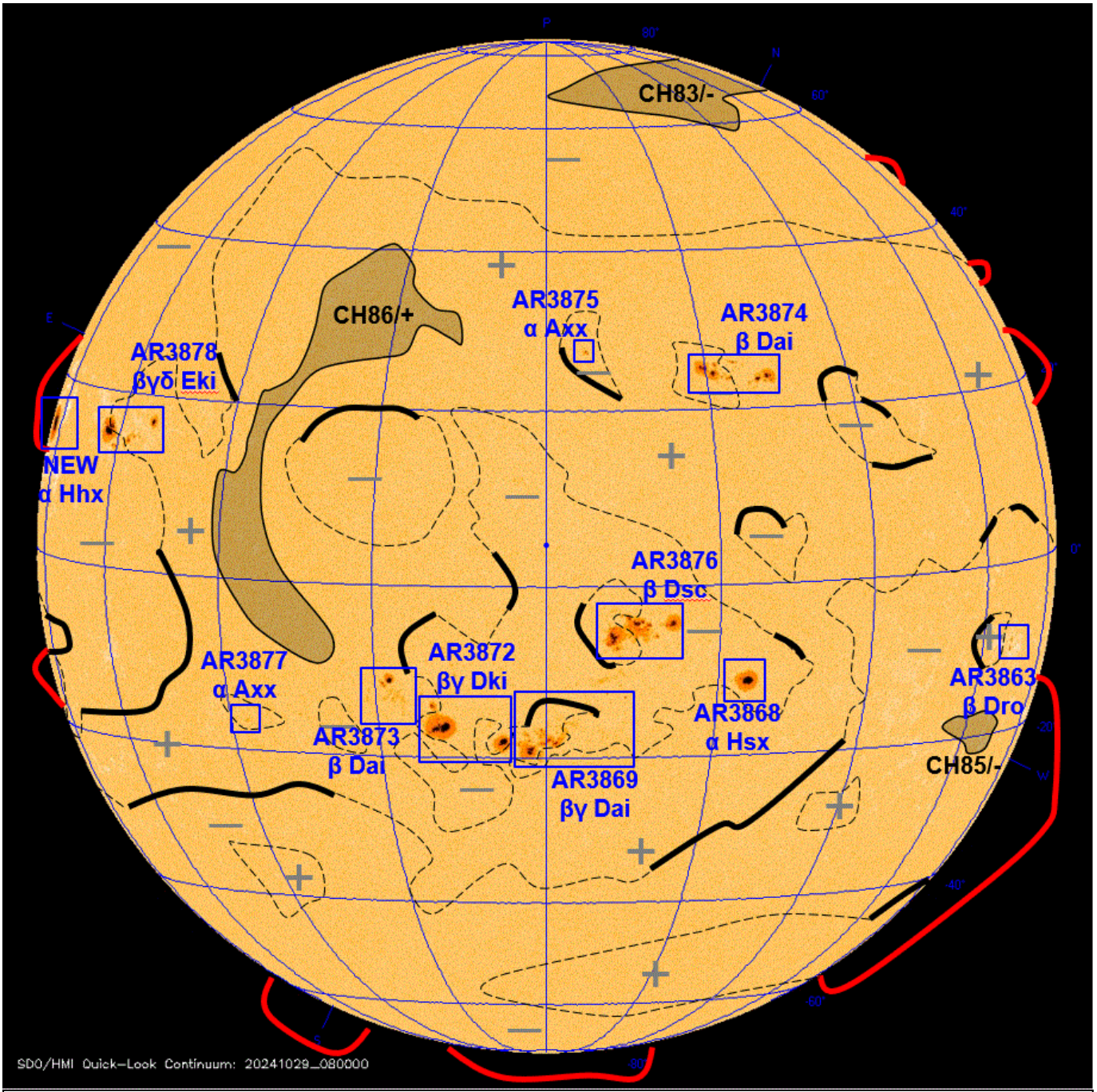
Figure 1: Solar Synoptic Map 29/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

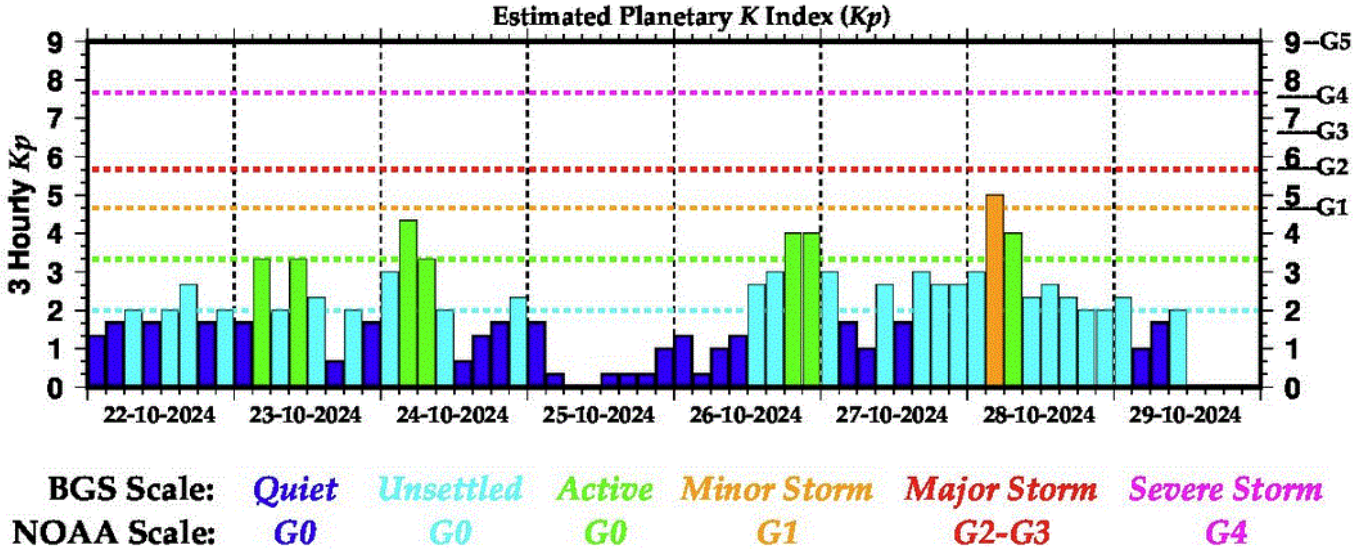
There are currently no Earth-directed CMEs.

Ongoing CME effects, from the arrival of the X1.8 flare early on 28 Oct are expected at first, with Slightly elevated solar winds. Solar winds are expected to ease from Slightly elevated to Background, however some influence from the fast wind of CH85/- may delay this until day 2 (30 Oct).

Geomagnetic activity is expected to ease to mostly Quiet, with isolated Unsettled spells from day 1 (29 Oct). However, given the location and history of the regions in the southeast disc, any further notable flares from these will have the potential to produce Earth-directed CMEs, and this geomagnetic forecast may change at short notice.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: BGS Geomagnetic Activity



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Radio Blackouts - X-Ray Flares

Moderate to High activity is expected, with further M-class flares and a chance of isolated X-class flares, given the complexity and number of regions on the disc. Significant flares are most likely to occur either from AR3878 near the northeast limb, the source of the latest M-class flare, or in the complex in the south approaching centre disc, which includes AR3869, AR3872, and AR3873-regions that have already produced two X-class flares in recent days.

Currently, there are eleven sunspots on the solar disc—ten numbered and one unnumbered. The largest is AR3872, positioned in a dense grouping in the southeast, now nearing the centre of the disc, with AR3873 to its east and AR3869 to its west. These regions have had a history of X-class flares, but have been undergoing simplification. In recent hours, the delta region at the rear of AR3872 has split, AR3869's positive leader spots have decayed into smaller spots, and nearly all positive leader spots in AR3873 have faded, save for one very small spot. AR3878 in the northeast continues to rotate away from the east limb, and still shows a strong delta spot within its large trailing spot. AR3876 in the south-centre and AR3874 in the northwest are both continuing to evolve but remain relatively simple bipolar groups. A new region is evident coming over the northeastern limb, but will need to rotate further on to the visible disc to conduct a proper analysis. The other regions are smaller and simpler.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	80	80
Very Active	R3-R5 (X Class)	No	20	20	20	20

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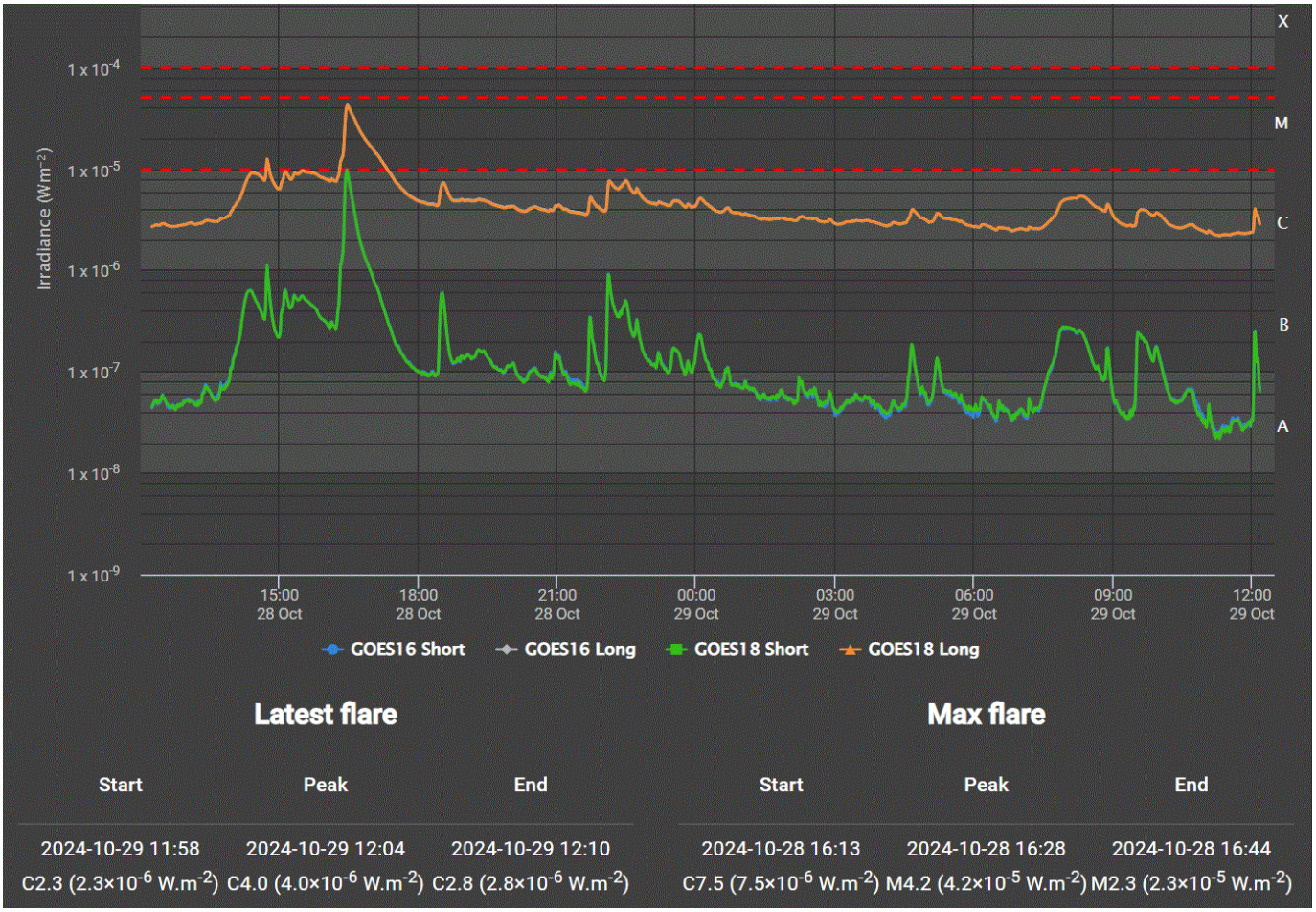
Figure 3: GOES-16/18 X-ray Flux



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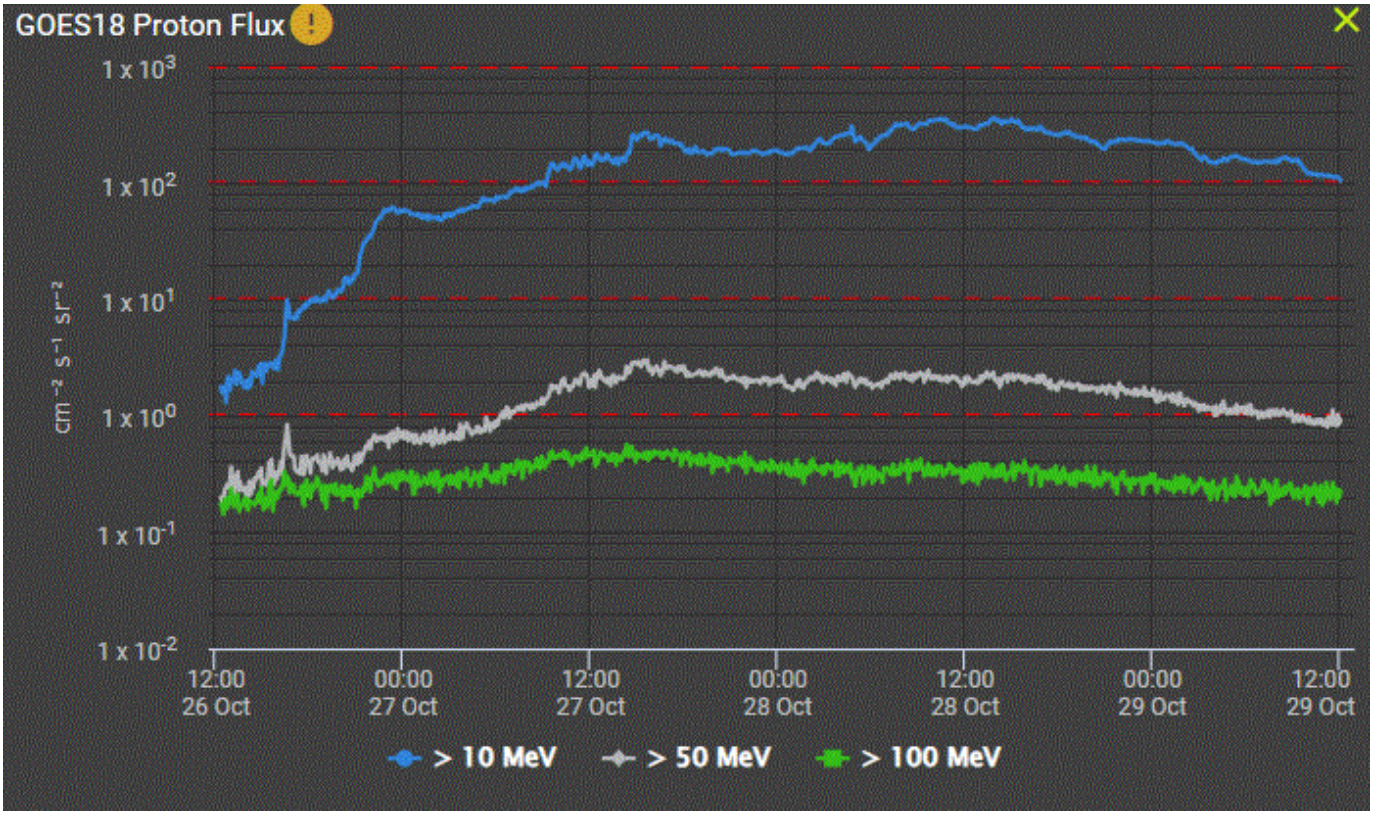
Solar Radiation Storms (High Energy Protons)

Recent CME and X-flare activity has elevated the high energy proton flux at GOES-18 to be currently at S2 moderate radiation storm levels, on a slow declining trend. A gradual decay is now expected, likely persisting just above the S2 level initially and decaying through the S1 level for the rest of day 1, and potentially into day 2 (29-30 Oct).

However, given their increasingly geoeffective location and the history of proton productive flares, any further significant flares from the regions approaching centre disc in the south have the potential to give further proton enhancement.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	50	30	10
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 >10Mev >50MeV and >100 MeV Proton Flux over the last 72 hours.



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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to remain at this level. The CME arrival early on the 28 Oct was weaker than originally anticipated, and any impact on the radiation belts from this is likely to be limited. As solar winds ease, there is chance of for spells of Moderate flux, however this is low confidence.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance to the overall trend, although this is likely to over-estimate the forecast fluence due to the current elevated winds.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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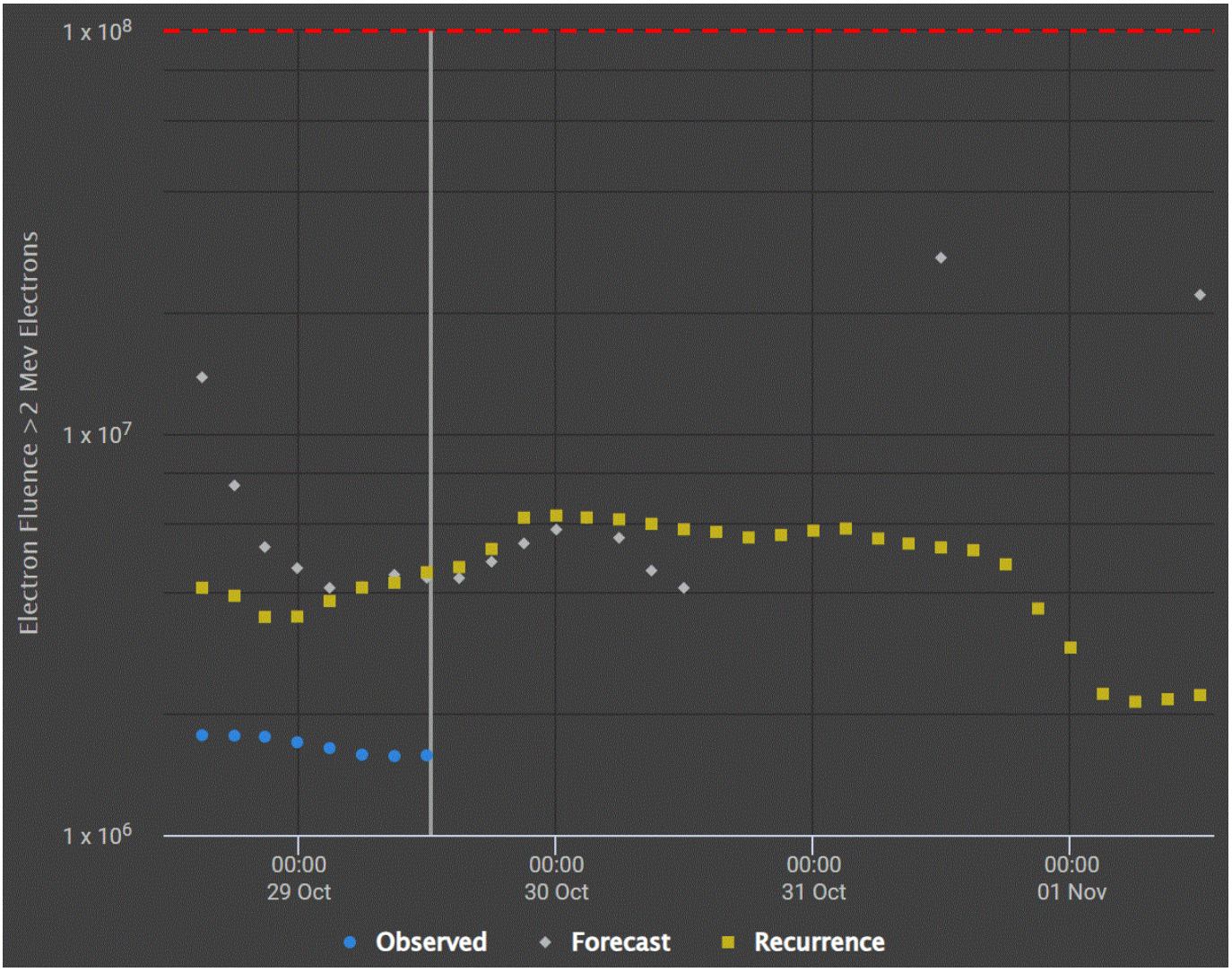
Figure 5: GOES-16 >2 MeV 24hr Electron Fluence with REFM and Recurrence.



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